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size, extent of surface, and mode of union, of its component bones. These, in their turn, are correlated with the articulation of the lower jaw, and with the amount of surface presented by the ascending ramus; with the neighboring fossæ, crests, and processes; with the dental series; and necessarily with the muscles concerned in mastication, varied as they are in their action.

The jugal arch, as it exists in the order of the *Carnivora*, offers perhaps the most instructive example of the various points to be considered in its morphology. Take the cranium of the tiger as a type of the cats (*Felidae*). In this, the arch, composed of three bones, —the squamosal, malar, and maxilla, —presents an extraordinary, horizontal curvature, thereby vastly increasing its expanse, giving great width to the temporal fossa, and consequently allowing a corresponding development of the temporal muscle, which, taking its origin from the largely expanded surface of the parietal, and from the occipito-sagittal crest, passes forwards and downwards, to be inserted into the high, wide, oblique, coronoid process of the mandible.

The increase in length of the arch, due to the great horizontal curvature, is also seconded by the advanced position of the orbit upon the skull, and to its height above the level of the articulation of the mandible.

The vertical curvature of the arch, with the convexity above and the concavity below, denotes increased power of resistance to the strain produced by the muscular fibres of the masseter, which, springing from the under side of the arch, are carried obliquely backward and downward to be inserted into the deeply grooved ascending ramus. The action of the pterygoids, which is similar to that of the masseter, is also relatively powerful. The fibres rising from the pterygoid fossæ and plates are inserted into the inside of the angular portion of the lower jaw, and into the neck of the condyle. The suture by which the jugal process of the squamosal and the malar are joined extends very obliquely through a greater portion of the arch; this obliquity imparting much strength to the bony structure, and giving force to assist the pressure upward.

The convex surface of the transverse condyle of the mandible, received into the deeply grooved glenoid cavity, forms the hinge-like articulation fitted for the vertical action of the jaw, and which is necessary for the prehension, tearing, and division of the flesh by means of the characteristic incisors, canines, and molars.

In the order of the *Edentata*, the cranium of the great ant-eater (*Myrmecophagus jubata*) exhibits a jugal arch which is the extreme opposite of that which has been thus partially described. In the ant-eater the arch is very incomplete, consisting of a short styloid process given off by a very rudimentary jugal, and of an extremely small, tuberos, zygomatic process from the squamosal, no union being formed between the two. There is no post-orbital process of the frontal, and indeed no separation between the orbital and temporal fossæ. Under these circumstances, the muscular development concerned in the preparation of the food is very feeble, correlated as it is with the entire absence of teeth, and any necessity for mastication.

Between these two extreme modifications there are many intermediate forms of the jugal arch. In some of the *Rodentia*, although the arch is relatively weak, as shown by the downward convexity in its vertical curvature, the masseter has other points of fixed insertion, by which means the masticatory powers are fully sustained. Moreover, the antero-posterior form of condyle is received into an undefined fossa situated upon the side of the cranial wall, whereby a corresponding amount of dental energy is imparted, suited to the habits of the rodent. Cope and Ryder have attributed the peculiarities of the dental system in this order to the mechanical consequences of an increase in the length of the incisors, which increase is due to their continued use. By a similar process of reasoning it may be shown that the imperfect condition of the arch in some of the other orders is correlated with an entire absence of the teeth, with a feeble muscular energy, and a loss of mastication, all being the result of continuous disuse.

In short, it may be said in general that the great development of the arch is dependent upon modifications which are strictly due to use, while its weakened and imperfect condition is equally the result of modifications which are due to disuse.

There seems as yet no evidence afforded by paleontological research to show that the jugal arch has undergone any special changes since the days of the *Creodonta*, the ancestors of the cats. We may therefore conclude that the phylogenesis of the *Carnivora*, at least, remains essentially the same, so far as this portion of the skull is concerned.

D. D. SLADE.

Cambridge, Mass., Dec. 5.

BOOK-REVIEWS.

A Revision of the South American Nematognathi or Cat-Fishes.

By CARL H. EIGENMANN, Ph.D., and ROSA SMITH EIGENMANN.

San Francisco, Cal. Acad. Sci. 8°. \$3.

THIS extensive work will be highly welcomed by ichthyologists. It is based on several thousand specimens from the Museum of Comparative Zoölogy at Cambridge, Mass. The material was collected chiefly during the Thayer Expedition. Besides that, numerous other collections were studied; for instance, that of Senhor Honorario, made in Goyaz, that made by his Majesty Dom Pedro II. in Rio Grande do Sul, and that made in Lake Titicaca by Professor Alexander Agassiz and Mr. S. Garman.

In all, 101 genera and 467 species are enumerated. Full descriptions of most of the species in the Museum of Comparative Zoölogy are given. The synonymy is treated in full, and the bibliography is given at the end of the volume. In this we should like to add Dr. C. B. Bruhl's "Osteologisches aus dem Pariser Pflanzengarten" (Wien, 1856), containing descriptions and figures of the osteology of *Aspredo*, *Loricaria*, and *Hypostoma*.

Besides the index of species and genera, a geographical index is added, and a map with especial reference to the localities where collections have been made. Both will be of great help to the student.

The different forms are referred to eight families, seven of which are confined to tropical America. The relationship of families and subfamilies is expressed by a phylogenetic diagram.

The nearly cosmopolitan family *Siluridae* (it is only absent in Australia) reaches its greatest development in South America, where it is represented by six subfamilies. The *Bunocephalidae* are found in the whole course of the Amazon and in Guiana. The *Diplomystidae* are represented by a single genus and species from Chili, the *Diplomystes papillosus*, Cuv. The family *Hypophthalmidae*, with the genera *Hypophthalmus* and *Helogenes*, is confined to the northern Amazon and Guiana. The *Pygidiidae* contain eleven genera, and are found in mountain-streams of Chili and the Argentine Republic. The *Argiidae*, the anatomy of which needs further study, have only three genera. They are characteristic of the Andes of Peru, Ecuador, and Colombia. The *Loricariidae*, with twenty-four genera, occur east from the Argentine Republic to Central America, west in Ecuador and Colombia. The seven genera of the *Callichthyidae* extend from La Plata to Rio Orinoco, and in the Amazon as far as Nauta.

The authors may be congratulated on this work, which will be of the greatest value to the student of fishes. Thanks are due to the California Academy of Sciences for publishing this work. It forms Volume I. of a new series of publications, called "Occasional Papers of the California Academy of Sciences."

AMONG THE PUBLISHERS.

"FROM Babel to Comparative Philology" is the title of a chapter in Dr. Andrew D. White's "Warfare of Science," which will open the January *Popular Science Monthly*. It gives the origin of the legend in regard to the great tower and the confusion of tongues, and also traces the early history of the belief that Hebrew was the only language spoken by God and men before Babel was undertaken. The second article in the great series on "The Development of American Industries since Columbus" will also appear in that number. The special topic is "Iron Mills and Puddling-Furnaces," being a part of the general subject of iron and steel, which is being treated by Mr. William F. Durfee. Like the opening paper, it is copiously illustrated, and much more readable than the title would indicate. Professor Huxley has attacked the idea that the people who spoke Aryan were one distinct race. His discussion of this point will be printed in the *Popular*